

“Study of Industrial Training of Electric Vehicle Production and Quality Control Practices at Kinetic Engineering, Ahilya Nagar.”

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Abstract

The rapid development of electric mobility has increased the importance of efficient production systems and stringent quality-control practices in the automotive industry. This paper presents a study of electric vehicle production and quality-control practices at Kinetic Engineering's Ahilya Nagar facility, with particular emphasis on manufacturing automation, chassis production, assembly, component inspection, and process quality. Kinetic has introduced automated manufacturing systems for its electric scooter production, including a robotic chassis line with automated welding, advanced fixtures, and a dedicated frame assembly cell. Individual quality gauges and kit-based component supply are also used to support production consistency and reduce downtime.

The study discusses the relationship between production technology and product quality in EV manufacturing. Important quality parameters include dimensional accuracy, welding quality, assembly accuracy, surface finish, corrosion resistance, component conformity, and functional performance. The study indicates that automation, in-process inspection, error-proofing, and systematic quality assurance can

contribute to improved production consistency and reduced manufacturing defects.

Keywords: Electric Vehicle, EV Manufacturing, Kinetic Engineering, Production, Quality Control, Robotic Welding, Chassis Manufacturing, Automation, Inspection, Electric Scooter.

1. Introduction

Electric vehicles are becoming an important part of the automotive industry because of the increasing demand for efficient and sustainable transportation. Unlike conventional vehicles, EVs incorporate electrical and electronic systems such as batteries, motor controllers, traction motors, battery-management systems, and associated wiring and control systems.

Manufacturing EVs requires accurate production processes because variations in components and assembly can affect vehicle performance, reliability, safety, and customer satisfaction. Research on electric-motor manufacturing has highlighted the importance of in-line quality monitoring and end-of-line testing in achieving consistent EV drivetrain performance.

Kinetic Engineering has expanded its manufacturing activities toward electric mobility. Its Ahilya Nagar

facility has introduced a fully automated robotic chassis line for Kinetic electric scooters. The line incorporates automated welding systems, advanced fixture technology, and a dedicated frame assembly cell.

2. Company and Manufacturing Overview

Kinetic Engineering is an established Indian automotive engineering and manufacturing organization. Its EV manufacturing activities include production related to electric scooters and EV components.

The company has reported manufacturing developments at its Ahilya Nagar facility, including:

- Electric scooter production
- Robotic chassis manufacturing
- Automated welding
- Frame assembly
- Metal body panel manufacturing
- Hydraulic and mechanical pressing
- Spot welding
- Pneumatic fixtures
- CED-based paint treatment
- Component quality inspection
- Kit-based material supply

These technologies are intended to improve manufacturing accuracy, consistency, production efficiency, and product quality.

Kinetic's EV activities also extend to battery manufacturing. Kinetic announced an EV battery manufacturing facility in Ahmednagar with a reported annual capacity of **60,000 battery packs**, including LFP and NMC battery types for two- and three-wheeler applications.

3. Objectives of the Study

The major objectives of this study are:

1. To study the EV production process at Kinetic Engineering.
2. To understand the manufacturing process of EV chassis and body components.
3. To study the application of automation and robotic systems in EV production.
4. To understand quality-control practices used during manufacturing.
5. To study dimensional inspection of automotive components.
6. To understand the importance of welding quality in EV chassis manufacturing.
7. To study the relationship between production efficiency and product quality.
8. To identify possible sources of manufacturing defects.
9. To study the role of fixtures, gauges and poka-yoke in quality assurance.
10. To suggest methods for improving EV production and quality.

4. EV Production Process

A generalized EV manufacturing process can be represented as:

Raw Material → Component Manufacturing → Chassis Manufacturing → Welding → Surface Treatment → Painting → Component Inspection → Sub-Assembly → EV Assembly → Electrical/Electronic Inspection → Functional Testing → Final Inspection → Dispatch

4.1 Raw Material

Raw materials such as sheet metal, tubes, structural sections and other engineering materials are processed according to component specifications.

4.2 Sheet Metal Processing

Sheet-metal components are manufactured using mechanical and hydraulic presses. Correct die alignment, material thickness and dimensional accuracy are important parameters.

4.3 Chassis Manufacturing

The chassis is a critical structural component of an electric scooter.

The manufacturing process generally involves:

- Tube/sheet preparation
- Cutting
- Forming
- Fixture loading
- Positioning
- Welding
- Dimensional inspection
- Surface treatment

Kinetic has reported the use of a **robotic chassis line** incorporating automated welding and dedicated frame assembly cells.

4.4 Welding

Welding is an important operation because the strength and dimensional accuracy of the chassis depend significantly on weld quality.

Important welding parameters include:

- Welding current
- Welding voltage
- Welding time
- Electrode condition
- Joint preparation
- Fixture positioning
- Weld size

- Weld penetration

Robotic welding can improve repeatability and consistency compared with highly manual operations.

5. EV Quality Control

Quality control is essential throughout the EV manufacturing process rather than only at the final inspection stage.

A suitable quality-control system can be divided into:

Incoming Quality Control

Inspection of purchased components and raw materials.

Typical checks include:

- Dimensions
- Material specifications
- Surface condition
- Electrical characteristics
- Supplier quality documents

In-Process Quality Control

Inspection during manufacturing operations.

Examples include:

- Dimensional inspection
- Welding inspection
- Torque verification
- Fixture inspection
- Surface inspection
- Component orientation
- Assembly verification

Final Quality Control

The completed EV is inspected before dispatch.

Typical checks include:

- Overall appearance
- Chassis dimensions
- Fastener condition
- Electrical connections
- Lighting system
- Brake operation
- Motor operation
- Controller functionality
- Battery-related parameters
- Functional road/dynamometer testing where applicable

6. Dimensional Quality Inspection

Dimensional accuracy is particularly important for chassis and frame components.

Common measuring instruments include:

- Vernier caliper
- Micrometer
- Height gauge
- Bore gauge
- Dial indicator
- Go/no-go gauges
- Special-purpose gauges

Kinetic reports the use of **individual quality gauges for components**, supporting consistent inspection during production.

The basic inspection procedure is:

Drawing Specification → Component Measurement → Compare With Tolerance → Accept/Reject → Corrective Action

7. Welding Quality

Welding defects can affect the structural integrity of an EV chassis.

Common welding defects include:

Defect	Possible Cause
Porosity	Gas contamination/improper shielding
Undercut	Excessive welding current
Lack of fusion	Improper heat input
Cracks	Thermal stress/material condition
Spatter	Incorrect welding parameters
Distortion	Uneven heating
Misalignment	Improper fixture positioning

The use of automated welding and dedicated fixtures can help improve repeatability and dimensional consistency.

8. Surface Treatment and Painting

Surface protection is important because automotive components are exposed to moisture, humidity and environmental conditions.

Kinetic has reported a **seven-tank coating process beginning with CED treatment followed by a metallic finish** for improved corrosion resistance and surface finish.

Important quality parameters include:

- Surface cleanliness
- Coating thickness
- Paint adhesion
- Uniformity
- Surface defects
- Corrosion resistance

- Colour consistency

9. Role of Automation in EV Production

Automation plays an important role in modern EV manufacturing.

The major advantages include:

1. Improved dimensional consistency
2. Repeatable production
3. Reduced human error
4. Improved welding accuracy
5. Reduced production time
6. Better workplace safety
7. Improved production monitoring
8. Consistent product quality

Research on EV manufacturing also indicates that automation, robotics and Industry 4.0 technologies can improve manufacturing efficiency and quality when properly implemented.

10. Quality Improvement Through Poka-Yoke

Poka-Yoke means mistake-proofing.

It is used to prevent incorrect assembly or detect errors before the product proceeds to the next operation.

Examples in EV manufacturing can include:

- Component orientation checking
- Connector mistake-proofing
- Fixture interlocking
- Correct-part verification
- Torque confirmation
- Sensor-based presence detection
- Barcode/traceability systems

Research on EV assembly identifies error prevention and process control as important aspects of improving assembly quality.

11. Production and Quality Relationship

Production quantity alone is not sufficient to evaluate manufacturing performance.

Important production-quality indicators include:

Production Rate

$$\text{Production Rate} = \frac{\text{Number of Components Produced}}{\text{Production Time}}$$

Defect Percentage

$$\text{Defect Percentage} = \frac{\text{Number of Defective Components}}{\text{Total Components Produced}} \times 100$$

First Pass Yield

$$\text{FPY} = \frac{\text{Good Units Produced Without Rework}}{\text{Total Units Produced}} \times 100$$

Rejection Rate

$$\text{Rejection Rate} = \frac{\text{Rejected Components}}{\text{Total Components Produced}} \times 100$$

These indicators can be used to evaluate the effectiveness of the EV production system.

12. Proposed Quality-Control Framework

A suitable EV quality framework can be represented as:

Supplier Quality

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Incoming Inspection

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Process Inspection

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Automated Welding & Assembly

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Dimensional Inspection

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Electrical/Electronic Inspection

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Functional Testing

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Final Quality Inspection

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Dispatch

This approach helps identify defects as early as possible rather than depending only on final inspection. Research on electric-motor manufacturing similarly emphasizes the advantages of in-line monitoring and defect prevention compared with detecting problems

only at the end of production.

13. Challenges in EV Manufacturing

The major challenges include:

- High dimensional accuracy requirements
- Battery safety
- Electrical safety
- Motor and controller reliability
- Supplier quality variation
- Welding defects
- Assembly errors
- Skilled manpower requirements
- Production-line balancing
- Traceability
- Battery quality consistency
- End-of-line testing

Battery manufacturing requires particularly stringent quality control because variations between cells can influence battery-pack performance and ultimately EV driving range.

14. Results and Discussion

The study indicates that modern EV manufacturing requires integration of **production engineering, automation and quality engineering**.

The implementation of a robotic chassis line at Kinetic's Ahilya Nagar facility demonstrates the movement toward automated and repeatable manufacturing processes. Automated welding, fixtures, individual component gauges and kit-based supply are reported as measures supporting production efficiency and quality.

From a quality perspective, inspection should be integrated throughout the manufacturing process. Dimensional inspection, welding inspection, surface-quality inspection and final functional

testing can collectively reduce the probability of defective products reaching customers.

The integration of automation with quality inspection can also provide opportunities for future Industry 4.0 implementation through data collection, real-time monitoring and predictive quality analysis.

15. Future Scope

Future improvements in EV manufacturing may include:

1. AI-based visual inspection.
2. Automated dimensional inspection.
3. IoT-based production monitoring.
4. Digital traceability of components.
5. Predictive maintenance.
6. Automated torque monitoring.
7. Digital twins for production-line optimization.
8. Real-time welding parameter monitoring.
9. Automated battery inspection.
10. Data-driven predictive quality control.

These technologies could help move EV production from traditional inspection toward **zero-defect and predictive manufacturing**.

16. Conclusion

This study presents an overview of EV production and quality-control practices associated with Kinetic Engineering's Ahilya Nagar manufacturing activities. The company's reported adoption of robotic chassis manufacturing, automated welding, advanced fixtures, quality gauges, improved component supply systems and surface-treatment processes demonstrates the increasing role of automation

and quality engineering in EV manufacturing.

Quality in EV manufacturing depends on controlling the entire production chain, from incoming materials and component manufacturing to chassis welding, assembly, electrical systems and final testing. The integration of automation, inspection, poka-yoke, process monitoring and data-based quality management can support higher consistency and manufacturing efficiency.

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